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Hecate Strait Juvenile Salmon Survey: 1987

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ABSTRACT

Morris, J. F. T. and M. C. Healey. 1988. Hecate Strait juvenile salmon survey: 1987. Can. Data Rep. Fish. Aquat. Sci. 701: 23 p.

In the summer of 1987, the Biological Sciences Branch of the Department of Fisheries and Oceans surveyed the juvenile salmon population of southeastern Hecate Strait by purse seine. The survey consisted of three cruises that took place from July 3 to July 7, from August 13 to August 14, and from August 19 to August 20. We conducted a similar survey in 1986 (Morris and Healey 1987).

The purpose of the survey was to gather information on the abundance, species composition, size composition, and diet of juvenile salmon in Hecate Strait. We will later analyse this information to evaluate how juvenile salmon use Hecate Strait as a migratory pathway and as a nursery ground.

This report presents the sampling information and data on juvenile salmon abundance and species composition that we collected. In addition, we present data on the adult salmon and non-salmonid species that were captured with the juvenile salmon and data on the thermal structure of southeastern Hecate Strait.

RÉSUMÉ

Morris, J. F. T. and M. C. Healey. 1988. Hecate Strait juvenile salmon survey: 1987. Can. Data Rep. Fish. Aquat. Sci. 701: 23 p.

Pendant l'été 1987, la direction des sciences biologiques du ministère des Pêches et des Océans a effectué dans le sud-est du détroit d'Hécate des relevés à la senne à poche pour étudier les populations de saumons juvéniles. L'étude comportait trois campagnes qui ont eu lieu du 3 au 7 juillet, les 13 et 14 août et les 19 et 20 août. Le même travail avait été réalisé en 1986 (Morris et Healey 1987).

L'étude avait pour objet de recueillir de l'information sur l'abondance, la composition par espèces et par tailles et l'alimentation des jeunes saumons dans le détroit d'Hécate. Nous analyserons par la suite cette information pour déterminer comment les jeunes saumons utilisent le détroit comme voie migratoire et comme nourricerie.

Le rapport présente l'information et les données recueillies au sujet de l'abondance des jeunes saumons et de la composition par espèces. Nous présentons aussi des données sur les saumons adultes et sur les non-salmonidés que nous avons capturés en même temps que les jeunes saumons, ainsi que sur la structure thermique du sud-est du détroit d'Hécate.

INTRODUCTION

In the summer of 1987, the Biological Sciences Branch of the Department of Fisheries and Oceans chartered a drum seiner to survey the juvenile salmon population of southeastern Hecate Strait. The survey consisted of three cruises that took place from July 3 to July 7, from August 13 to August 14, and from August 19 to August 20. We conducted a similar survey in 1986 (Morris and Healey 1986).

The primary purpose of this survey was to gather data on the abundance, species composition, size composition, and diet of juvenile salmon in Hecate Strait. We will use the information to validate a migration model constructed by Healey (1986) that predicts juvenile salmon occurrence, size, and food resource requirements in Hecate Strait from different assumptions about smolt production, run timing, growth rate, migration speed, and migration route for each species from six B.C. coastal regions. In this way, we will evaluate how juvenile salmon use Hecate Strait as a migration corridor and as a nursery ground.

This report presents the sampling information and the data on juvenile salmon abundance and species composition that we collected. In addition, we present data on the adult salmon and non-salmonid species that were captured with the juvenile salmon, and data on the thermal structure of the sampled waters of southeastern Hecate Strait.

METHODS

Vessel and fishing gear

The Department of Fisheries and Oceans chartered the fishing vessel, the A.L.H., for the survey. The A.L.H. is a 20 meter commercial drum seiner that is owned by the Canadian Fishing Company and skippered by Mr. Glenn Budden.

To capture juvenile salmon, we used a small mesh bunt that was stitched onto the bunt end of a commercial salmon seine. The small mesh bunt is 55 meters in length and 73 meters deep, and fishes at approximately 60 meters. The stretch mesh size is 1.27 centimeters. The mesh material is 210/20 knotless nylon. The commercial purse seine is 384 meters in length and 64 meters deep, and fishes at approximately 40 meters. To assist in making purse seine sets, we used a 6 meter skiff powered by a 100 H.P. diesel engine.

Duties of Skipper, crew, and fisheries observer

The skipper and crew of the A.L.H. operated the vessel, handled the net, and conducted the purse seining. The fisheries observer on board discussed the sampling strategy with the skipper, preserved the juvenile salmon catch, sorted, weighed, and took forklengths of the non-salmonid catch, recorded observations on physical conditions associated with each purse seine set, and deployed XBT probes (expendable bathythermographs, manufactured by Sippican Ocean Systems) to obtain a vertical temperature profile of the sample locations in Hecate Strait.

The physical conditions that were recorded were sea surface temperature, sea depth, cloud cover, visibilty, precipation, wind speed and direction, sea state, and the strength and direction of tidal currents. We obtained sea surface temperatures by inserting a mercury thermometer into a bucket of sea water taken from the sea surface, sea depths from an installed SI-TEX depth sounder, estimated wind speeds from sea state observations with reference to the Beaufort scale, and the estimated strength and direction of the tidal currents by the drift of the vessel while towing the purse seine.

Purse seineing technique

The crew of the A.L.H. set on the starboard side of the vessel and towed the purse seine in a half set position with the assistance of the power skiff for 20 minutes before closing the circle and winding the net back on the drum. Each set took approximately 50 minutes to complete.

To test the hypothesis that the juvenile salmon were migrating northward along the coast through Hecate Strait, we made two sets at most locations; one set with the open side of the towed net facing north and the other with the open side facing south. Presumably, if the hypothesis is true, then more juveniles should be caught when the net is towed southward.

Treatment of the samples

We preserved the juvenile salmon samples in 10% formalin. At the end of each cruise we brought the samples back to the wet laboratory at the Pacific Biological Station where we sorted them by species and measured their lengths and weights.

We sorted the non-salmonid catch from each set by species, weighed the total catch of each species, and then took forklengths of the individual fish within each species.

Sampling locations

The original sampling strategy was to cover the southeastern area of Hecate Strait by making purse seine sets at right angles to the coast extending from the south tip of Price Island (52°15' N) to Banks Island (53° 20' N). These transects were to consist of two sets at each of the following four sampling locations: off the beach, 6.5 km offshore, 13.0 km offshore, and 19.0 km offshore provided bottom topography was suitable. We planned to complete one transect each day over two 5-day cruises that were scheduled for the first week of July and the third week of August. In p ictice, we were forced to deviate from this sampling strategy because of bad weather and time restrictions imposed by an agreement we made with the contracter that the charter would not conflict with commercial fisheries openings.

The July cruise took place from July 3 to July 7. On this cruise, we completed transects off the south tip of Price Island, the south end of Aristazabal Island, the north end of Aristazabal Island, and a short transect off the approximate mid-latitude point of the Estevan Island Group. We also made sets in Nepean Sound, Estevan Sound, Caamano Sound, and off the south end of Aristazabal Island.

The scheduled August cruise was split into two cruises that took place from August 13 to August 14, and from August 19 to 20 to allow the fishermen to participate in a commercial fisheries opening taking place over the intervening week-end. On the August 13-14 cruise, we completed short transects off the south and north ends of Aristazabal Island and made some sets in Laredo Channel. On the August 19-20 cruise, we completed a transect off the south end of Banks Island and made two sets off the approximate mid-latitude point of the Estevan Island Group.

The following is a daily account of the July 3-7, August 13-14, and August 19-20 cruises.

The July 3-7 cruise:

July 3

We started a transect off McInnes Island, which is just off the tip of the south end of Price Island, by setting off the beach at McInnes Island and 6.5 km further offshore.

July 4

We completed the transect off McInnes Island by setting at 13.0 km and 19.3 km offshore. We then completed a second transect off the south end of Aristazabal Island by making one set 8.0 km offshore, one set 11.3 km offshore, and two sets 14.5 km offshore.

July 5

We completed a transect off the north end of Aristazabal Island by setting off the beach and then 6.5, 13.0, and 19.3 km offshore.

July 6

We completed only a short transect off the mid-latitude point of the Estevan Island Group. We set off the beach and 8.0 km. offshore but then we had to abandon our plans to set at 16.0 and 24.0 km offshore along this transect because of rough seas and high winds. As an alternative, we ran to the more protected waters of Nepean Sound where we made one more set.

July 7

Again, rough seas prevented us from completing the planned transect off the south coast of Banks Island. We did make one set off the beach but then decided to return to the more protected inland waters where we made sets in Nepean Sound, Estevan Sound, and Caamano Sound. By the afternoon, the seas on Hecate Strait had calmed down, so we completed a short transect off the the north end of Aristazabal Island consisting of one set off the beach and another 5 miles offshore.

August 13-14 cruise:

August 13

We completed a short transect off the south end of Aristazabal Island along which we set off the beach and 8.0 km offshore.

August 14

We completed only a short transect off the north end of Aristazabal Island along which we set one mile off the beach of Rennison Island and 8.0 km offshore. After that rough seas forced us to run to the more sheltered inland waters of Laredo Channel where we made three sets.

August 19-20 cruise:

August 19

We completed a transect off the south end of Banks Island consisting of sets two miles south of Terror Point on Banks Island, 8.0 km offshore, 16.0 km offshore, and 24.0 miles offshore.

August 20

We had planned to do a transect off the approximate mid-latitude point of the Estevan Island Group, but instead we made only two sets 24 km

offshore. The transect was cancelled so that the fishermen could arrive on time to participate in a commercial sockeye fishery in the Strait of Juan de Fuca that had just been announced over the marine radio.

DATA

Table 1 gives the date, loran coordinates, and a description of the approximate geographic location of each set.

Table 2 gives the date, time, sea surface temperature, sea depth, and the direction the net was towed for 20 minutes and describes the weather, sea conditions, and tidal currents for each set.

Table 3 presents the data on the number of juvenile salmon of each species and the total number of juvenile salmon that were caught in each set, as well as cruise totals and survey totals. In set 8, the number of juveniles given is an estimate that was calculated by multiplying the number of juveniles in a sub-sample by the ratio of the catch weight to the sub-sample weight. As a consequence, the July 3-7 cruise totals and the survey totals are themselves estimates.

Table 4 presents the data on the number of adult salmon of each species and the total number of adult salmon that were caught in association with the juvenile salmon in each set, as well as cruise totals and survey totals.

Table 5 presents the data on the number and length frequencies of herring that were caught in association with juvenile salmon for sets where the number of herring exceeded three fish. We calculated the mean lengths and standard deviations of the herring from the length frequency data for each set in the table. We recorded the total weight of the herring catch in the set only if the weight exceeded 3 kg because the deck balance used is not accurate for samples less than this weight.

Table 6 presents the data on the number and length frequencies of male, female, and all dogfish that were caught in association with juvenile salmon for sets where the number of dogfish caught exceeded three fish. We calculated the mean lengths and standard deviations of male, female, and all dogfish from the length frequency data. We also recorded the total weight of the dogfish catch in the set.

Table 7 presents the data on the number and forklengths of herring, dogfish, and rockfish that were caught in association with juvenile salmon for sets where the number of each species was three or less.

Table 8 presents the vertical temperature profiles at sampling locations where we deployed an XBT probe. We transcribed the temperatures from the XBT recordings.

The scientific names for the fish species mentioned in these tables are as follows: pink salmon, Oncorhyncus gorbuscha; chum salmon, O. keta; sockeye salmon, O. nerka; chinook salmon, O. tshawytscha; coho salmon, O. kisutch; herring, Clupea pallasii; spiny dogfish, Squalus acanthias; and black rockfish, Sebastes melanops.

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We would like to thank Mr. Glenn Budden and the crew of the A.L.H. for their cooperation, their hard work, and for sharing their knowledge of purse seining. Their enthusiasm made these cruises a very enjoyable experience.

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TABLE 1. PURSE SEINE SET LOCATIONS.

SET	DATE	LATITUDE	LONGITUDE	LOCATION
CRUISE 1, JULY 3-7,1987.				
1	03/07/87	52°15.00' N	128°44.07' W	Off beach at McInnes Island, near south end of Price Island.
2	03/07/87	52°14.09' N	128°44.08' W	Off beach at McInnes Island, near south end of Price Island.
3	03/07/87	52°15.02' N	128°50.30' W	6.5 km. offshore from McInnes Island.
4	03/07/87	52°15.00' N	128°50.15' W	6.5 km. offshore from McInnes Island.
5	04/07/87	52°15.10' N	128°56.91' W	13.0 km. offshore from McInnes Island.
6	04/07/87	52°15.00' N	128°56.69' W	13.0 km. offshore from McInnes Island.
7	04/07/87	52°15.00' N	129°03.33' W	19.3 km. offshore from McInnes Island.
8	04/07/87	52°15.00' N	129°03.13' W	19.3 km. offshore from McInnes Island.
9	04/07/87	52°26.50' N	129°14.86' W	14.5 km. offshore from south end of Aristazabal Island.
10	04/07/87	52°26.50' N	129°14.80' W	14.5 km. offshore from south end of Aristazabal Island.
11	04/07/87	52°26.54' N	129°10.96' W	11.3 km. offshore from south end of Aristazabal Island.
12	04/07/87	52°26.52' N	129°07.49' W	8.0 km. offshore from south end of Aristazabal Island.
13	05/07/87	52°47.22' N	129°24.52' W	Off beach at north end of Aristazabal Island.
14	05/07/87	52°47.09' N	129°24.20' W	Off beach at north end of Aristazabal Island.
15	05/07/87	52°47.05' N	129°30.90' W	6.4 km. offshore from north end of Aristazabal Island.
16	05/07/87	52°46.92' N	129°30.99' W	6.4 km. offshore from north end of Aristazabal Island.
17	05/07/87	52°47.19' N	129°37.37' W	13.0 km. offshore from north end of Aristazabal Island.
18	05/07/87	52°47.00' N	129°37.40' W	13.0 km. offshore from north end of Aristazabal Island.
19	05/07/87	52°47.13' N	129°43.89' W	19.3 km. offshore from north end of Aristazabal Island.
20	05/07/87	52°47.00' N	129°44.00' W	19.3 km. offshore from north end of Aristazabal Island.
21	06/07/87	53°00.50' N	129°42.31' W	Off beach from mid-latitude of Estevan island group.
22	06/07/87	53°00.03' N	129°42.65' W	Off beach from mid-latitude of Estevan island group.
23	06/07/87	53°00.74' N	129°49.95' W	8.0 km. offshore from mid-latitude of Estevan island group.
24	06/07/87	53°00.41' N	129°50.11' W	8.0 km. offshore from mid-latitude of Estevan island group.
25	06/07/87	53°09.71' N	129°39.86' W	Nepean Sound.
26	07/07/87	53°08.02' N	129°57.74' W	Off beach at south end of Banks Island.
27	07/07/87	53°08.78' N	129°40.48' W	Nepean Sound.
28	07/07/87	53°04.48' N	129°31.31' W	Mid-latitude of Estevan Sound.
29	07/07/87	52°56.30' N	129°25.30' W	Caamano Sound.
30	07/07/87	52°47.07' N	129°25.25' W	Off beach at north end of Aristazabal Island.
31	07/07/87	52°46.92' N	129°31.38' W	8.0 km. offshore from north end of Aristazabal Island.

TABLE 1 (CONTINUED).

SET	DATE	LATITUDE	LONGITUDE	LOCATION
CRUISE 2, AUGUST 13-14,1987.				
32	13/08/87	52°26.62' N	129°07.46' W	8.0 km. offshore from south end of Aristazabal Island.
33	13/08/87	52°26.62' N	129°07.46' W	8.0 km. offshore from south end of Aristazabal Island.
34	13/08/87	52°26.64' N	129°14.60' W	14.5 km. offshore from south end of Aristazabal Island.
35	13/08/87	52°26.56' N	129°14.60' W	14.5 km. offshore from south end of Aristazabal Island.
36	14/08/87	52°46.95' N	129°24.93' W	Off beach at north end of Aristazabal Island.
37	14/08/87	52°47.00' N	129°25.00' W	Off beach at north end of Aristazabal Island.
38	14/08/87	52°47.09' N	129°30.81' W	8.0 km. offshore from north end of Aristazabal Island.
39	14/08/87	52°46.51' N	129°30.85' W	8.0 km. offshore from north end of Aristazabal Island.
40	14/08/87	52°51.24' N	129°12.52' W	North end of Loredo Channel.
41	14/08/87	52°43.77' N	129°04.19' W	Mid-latitude of Loredo Channel.
42	14/08/87	52°35.43' N	128°55.08' W	South end of Loredo Channel.
CRUISE 3, AUGUST 19-20,1987.				
43	19/08/87	53°08.06' N	130°22.38' W	24.0 km. offshore from south end of Banks Island.
44	19/08/87	53°07.74' N	130°22.29' W	24.0 km. offshore from south end of Banks Island.
45	19/08/87	53°07.72' N	130°14.12' W	16.0 km. offshore from south end of Banks Island.
46	19/08/87	53°08.02' N	130°14.01' W	16.0 km. offshore from south end of Banks Island.
47	19/08/87	53°08.06' N	130°05.50' W	8.0 km. offshore from south end of Banks Island.
48	19/08/87	53°07.69' N	130°05.80' W	8.0 km. offshore from south end of Banks Island.
49	19/08/87	53°08.00' N	129°57.20' W	3.2 km. offshore from south end of Banks Island.
50	19/08/87	53°07.68' N	129°57.33' W	3.2 km. offshore from south end of Banks Island.
51	20/08/87	53°00.78' N	130°06.66' W	24.0 km. offshore from mid-latitude of Estevan island group.
52	20/08/87	53°00.78' N	130°06.66' W	24.0 km. offshore from mid-latitude of Estevan island group.

TABLE 2. THE WEATHER, SEA CONDITIONS, SEA SURFACE TEMPERATURE (SST), SEA DEPTH, TIDE, AND DIRECTION THE PURSE SEINE WAS TOWED FOR EACH SET.

SET	DATE	TIME	SKY	WIND DIR.	WIND SP. (KM/HR)	SEA SURFACE	SST (°C)	DEPTH (METERS)	TIDE	DIRECTION OF TOW
CRUISE 1, JULY 3-7, 1987.										
1	03/07/87	16:25	CLEAR	NW	2-6	RIPPLED	14.0	160	FLOOD	SOUTH
2	03/07/87	17:29	CLEAR	NW	2-6	RIPPLED	14.0	160	FLOOD	NORTH
3	03/07/87	19:00	CLEAR	NW	2-6	RIPPLED	14.2	208	FLOOD	SOUTH
4	03/07/87	20:33	CLEAR	NW	2-6	RIPPLED	14.2	210	FLOOD	NORTH
5	04/07/87	6:00	CLEAR	NW	2-6	RIPPLED	14.2	110	SLACK	SOUTH
6	04/07/87	7:20	CLEAR	NW	2-6	RIPPLED	14.2	120	EBB	NORTH
7	04/07/87	8:58	PARTLY CLOUDY	NW	2-6	RIPPLED	14.2	186	EBB	SOUTH
8	04/07/87	10:08	PARTLY CLOUDY	NW	2-6	RIPPLED	14.2	186	EBB	NORTH
9	04/07/87	13:42	PARTLY CLOUDY	NW	2-6	RIPPLED	14.0	116	FLOOD,WEAK	SOUTH
10	04/07/87	14:40	PARTLY CLOUDY	NW	2-6	RIPPLED	14.0	120	FLOOD,STRONG	NORTH
11	04/07/87	16:07	PARTLY CLOUDY	NW	2-6	RIPPLED	14.0	90	FLOOD	NO TOWING
12	04/07/87	17:12	PARTLY CLOUDY	NW	2-6	RIPPLED	14.0	112	FLOOD	SOUTH
13	05/07/87	6:35	PARTLY CLOUDY		< 2	LIKE A MIRROR	11.5	160	FLOOD,STRONG	SOUTH
14	05/07/87	7:40	PARTLY CLOUDY		< 2	LIKE A MIRROR	11.5	170	FLOOD	NORTH
15	05/07/87	9:20	PARTLY CLOUDY		< 2	LIKE A MIRROR	12.0	410	SLACK	SOUTH
16	05/07/87	10:20	PARTLY CLOUDY		< 2	LIKE A MIRROR	12.0	426	EBB	NORTH
17	05/07/87	11:52	PARTLY CLOUDY		< 2	LIKE A MIRROR	12.0	150	EBB	SOUTH
18	05/07/87	12:52	PARTLY CLOUDY		< 2	LIKE A MIRROR	12:0	160	EBB	NORTH
19	05/07/87	14:30	PARTLY CLOUDY		< 2	LIKE A MIRROR	13.0	214	FLOOD	SOUTH
20	05/07/87	15:22	PARTLY CLOUDY		< 2	LIKE A MIRROR	13.0	214	FLOOD	NORTH
21	06/07/87	6:45	OVERCAST	SE	7-11	WAVELETS,NOT BREAKING	11.0	218	FLOOD,STRONG	SOUTH
22	06/07/87	8:10	OVERCAST	SE	7-11	WAVELETS,NOT BREAKING	11.0	200	FLOOD	NORTH
23	06/07/87	9:23	OVERCAST	SE	12-18	SCATTERED WHITECAPS	12.0	328	SLACK	SOUTH
24	06/07/87	10:25	OVERCAST	SE	30-38	MODERATE WAVES,7 FT.SWELL	12.0	332	SLACK	NORTH
25	06/07/87	14:00	OVERCAST	SE	7-11	WAVELETS	12.0	166	SLACK	SOUTH
26	07/07/87	6:20	OVERCAST	SE	12-18	WHITECAPS,10 FT. SWELL	12.0	116	FLOOD	SOUTH
27	07/07/87	8:40	OVERCAST	SE	2-6	RIPPLED	12.0	160	SLACK	SOUTH
28	07/07/87	10:40	OVERCAST	SE	2-6	RIPPLED	12.0	120	EBB	SOUTH
29	07/07/87	12:36	PARTLY CLOUDY		< 2	LIKE A MIRROR	12.0	180	EBB	SOUTH
30	07/07/87	14:30	PARTLY CLOUDY		< 2	LIKE A MIRROR	12.0	102	EBB	SOUTH
31	07/07/87	16:15	PARTLY CLOUDY	SE	2-6	RIPPLED	13.5	206	EBB	SOUTH

TABLE 2 (CONTINUED).

SET	DATE	TIME	SKY	WIND DIR.	WIND SP. (KM/HR)	SEA SURFACE	SST (°C)	DEPTH (METERS)	TIDE	DIRECTION OF TOW
CRUISE 2, AUGUST 13-14, 1987.										
32	13/08/87	13:02	CLEAR	NW	12-18	WHITECAPS	11.5	140	FLOOD	SOUTH
33	13/08/87	14:35	CLEAR	NW	12-18	WHITECAPS	11.5	140	FLOOD	NORTH
34	13/08/87	16:35	CLEAR	NW	12-18	WHITECAPS	10.5	106	SLACK	SOUTH
35	13/08/87	18:02	CLEAR	NW	12-18	WHITECAPS	10.5	120	EBB	NORTH
36	14/08/87	7:05	PARTLY CLOUDY	NW	7-11	WAVELETS	10.0	110	EBB	SOUTH
37	14/08/87	8:30	PARTLY CLOUDY	NW	7-11	WAVELETS	10.0	140	EBB	NORTH
38	14/08/87	10:00	OVERCAST	NW	12-18	WHITECAPS	10.0	426	EBB	SOUTH
39	14/08/87	11:10	OVERCAST	NW	12-18	WHITECAPS	10.0	462	SLACK	NORTH
40	14/08/87	14:00	PARTLY CLOUDY	NW	7-11	WAVELETS	10.5	136	FLOOD	SOUTH
41	14/08/87	16:15	PARTLY CLOUDY	NW	7-11	WAVELETS	10.0	290	FLOOD	SOUTH
42	14/08/87	18:30	PARTLY CLOUDY	NW	7-11	WAVELETS	12.5	186	EBB	SOUTH
CRUISE 3, AUGUST 19-20, 1987.										
43	19/08/87	9:10	CLOUDY	NW	2-6	RIPPLED	12.5	226	FLOOD	SOUTH
44	19/08/87	10:10	CLOUDY	NW	2-6	RIPPLED	12.5	226	FLOOD	NORTH
45	19/08/87	11:55	CLOUDY	NW	7-11	WAVELETS	13.5	114	EBB	NORTH
46	19/08/87	12:52	CLOUDY	NW	7-11	WAVELETS	13.5	128	EBB	SOUTH
47	19/08/87	14:21	CLOUDY	SW	7-11	WAVELETS	13.5	84	EBB	SOUTH
48	19/08/87	15:15	CLOUDY	SW	7-11	WAVELETS	13.5	140	EBB	NORTH
49	19/08/87	17:03	CLOUDY	W	12-18	WHITECAPS	13.0	88	SLACK	SOUTH
50	19/08/87	17:51	CLOUDY	W	12-18	WHITECAPS	13.0	124	FLOOD	NORTH
51	20/08/87	7:45	PARTLY CLOUDY		< 2	LIKE A MIRROR, 1 FT SWELL	14.0	262	FLOOD	SOUTH
52	20/08/87	8:47	PARTLY CLOUDY		< 2	LIKE A MIRROR	14.0	262	FLOOD	NORTH

TABLE 3. THE NUMBER OF JUVENILE PINK, CHUM, SOCKEYE, COHO, AND CHINOOK SALMON CAUGHT IN EACH SET.

SET	PINK	CHUM	SOCKEYE	COHO	CHINOOK	TOTAL
CRUISE 1, JULY 3-7, 1987.						
1	0	0	0	5	0	5
2	5	6	0	5	1	17
3	403	39	14	5	0	461
4	66	17	2	0	0	85
5	498	104	43	6	1	652
6	27	5	2	0	0	34
7	1551	317	153	3	0	2024
8	11833	2079	406	0	0	14318 *
9	286	35	3	89	0	413
10	893	109	22	26	0	1050
11	166	18	3	11	1	199
12	228	25	3	53	0	309
13	10	5	0	1	0	16
14	1066	107	3	2	0	1178
15	14	2	1	0	0	17
16	0	0	0	0	0	0
17	628	97	7	3	0	735
18	1	6	0	0	0	7
19	1600	254	32	61	0	1947
20	5	11	0	6	0	22
21	15	4	0	8	0	27
22	0	0	0	14	1	15
23	115	24	2	3	0	144
24	162	14	2	0	0	178
25	2	0	0	1	0	3
26	1141	86	11	12	0	1250
27	4	0	1	3	0	8
28	4	0	0	2	0	6
29	358	27	1	25	0	411
30	148	14	2	18	0	182
31	0	0	0	6	0	6
CRUISE TOTALS	21229	3405	713	368	4	25718

* For set 8, the juvenile salmon catch shown is an estimate that was obtained by multiplying the number of juveniles in a sub-sample by the ratio of the catch weight to the sample weight. The sub-sample weighed 9.5 kg. and the juvenile salmon catch weighed 148.5 kilograms. The number of juvenile salmon of each species in the sub-sample was pinks, 757; chum, 133; sockeye, 26; coho, 0; and chinook, 0.

TABLE 3 (CONTINUED).

SET	PINK	CHUM	SOCKEYE	COHO	CHINOOK	TOTAL
CRUISE 2, AUGUST 13-14, 1987.						
32	184	11	11	22	2	230
33	5	0	2	2	1	10
34	125	28	15	5	0	173
35	44	1	3	1	0	49
36	425	2	9	3	2	441
37	30	0	0	3	0	33
38	110	0	8	11	0	129
39	16	0	0	6	0	22
40	18	0	1	3	0	22
41	12	5	0	9	2	28
42	18	2	0	15	0	35
CRUISE TOTALS	987	49	49	80	7	1172
CRUISE 3, AUGUST 19-20, 1987.						
43	289	5	10	0	0	304
44	217	4	8	0	0	229
45	326	9	10	0	0	345
46	57	0	2	0	0	59
47	72	1	0	0	0	73
48	1037	7	12	0	0	1056
49	53	0	1	14	1	69
50	200	1	16	2	1	220
51	312	10	6	0	0	328
52	54	8	0	0	0	62
CRUISE TOTALS	2617	45	65	16	2	2745
SURVEY TOTALS	24833	3499	827	464	13	29635

TABLE 4. THE NUMBER OF ADULT PINK, CHUM, SOCKEYE, COHO, AND CHINOOK SALMON ASSOCIATED WITH THE JUVENILE SALMON CATCH IN EACH SET.

SET	PINK	CHUM	SOCKEYE	COHO	CHINOOK	TOTAL
CRUISE 1, JULY 3-7, 1987.						
1	0	2	4	0	1	7
2	10	0	5	3	3	21
3	1	0	1	0	0	2
4	0	0	0	0	0	0
5	2	0	0	0	0	2
6	1	0	0	0	0	1
7	1	0	1	0	0	2
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	2	2	0	1	0	5
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	2	0	1	0	3
15	0	4	0	0	0	4
16	0	0	0	0	0	0
17	1	0	0	2	0	3
18	0	0	0	1	0	1
19	1	2	1	0	0	4
20	1	1	0	0	0	2
21	1	0	0	2	0	3
22	4	0	0	1	1	6
23	1	1	0	1	1	4
24	1	0	0	0	0	1
25	0	0	0	0	0	0
26	1	2	0	0	0	3
27	0	0	0	0	0	0
28	0	0	0	0	0	0
29	6	0	1	5	0	12
30	3	0	0	0	0	3
31	0	0	0	0	0	0
CRUISE TOTALS	37	16	13	17	6	89

TABLE 4 (CONTINUED).

SET	PINK	CHUM	SOCKEYE	COHO	CHINOOK	TOTAL
CRUISE 2, AUGUST 13-14, 1987.						
32	2	0	0	0	0	2
33	2	0	2	4	1	9
34	0	0	0	0	1	1
35	0	0	0	0	2	2
36	3	12	0	3	0	18
37	0	0	0	0	0	0
38	1	0	0	2	0	3
39	5	3	2	6	1	17
40	1	1	0	2	0	4
41	0	0	0	1	0	1
42	1	15	0	2	1	19
CRUISE TOTALS	15	31	4	20	6	76
CRUISE 3, AUGUST 19-20, 1987.						
43	0	0	0	1	0	1
44	2	1	0	0	0	3
45	0	0	0	0	0	0
46	0	0	0	0	0	0
47	0	0	0	0	0	0
48	0	0	0	0	0	0
49	0	0	0	1	0	1
50	96	3	16	5	1	121
51	0	0	0	0	0	0
52	0	0	0	0	0	0
CRUISE TOTALS	98	4	16	7	1	126
SURVEY TOTALS	150	51	33	44	13	291

TABLE 5. THE NUMBER, LENGTH FREQUENCY, AND TOTAL WEIGHT OF HERRING PER SET.

LENGTH / (CM) /	SET 3	4	19	22	26	27	28	34	43	44	45
					FREQUENCY						
14.0-14.9		3									
15.0-15.9		31									
16.0-16.9		67			7						
17.0-17.9		74	1		12		1		2	1	
18.0-18.9	2	38	18		4		1		4	6	
19.0-19.9		17	6	1	2			4	1	24	
20.0-20.9		6	8		2		1	2	5	14	
21.0-21.9		3	8	1						11	1
22.0-22.9		2	8	1			2	1	2	3	2
23.0-23.9			5	1	1	2	3		1	1	2
24.0-24.9			10	1	1	3	4		2	9	2
25.0-25.9			12	2	1	3	2		6	7	2
26.0-26.9	2		3	1		1	1		4	6	1
27.0-27.9	4			1		1	1			3	
28.0-28.9	2		3								
29.0-29.9				1						1	
NUMBER/SET	10	241	82	10	30	10	16	7	27	86	10
MEAN LENGTH	26.65	17.34	22.12	24.55	18.38	25.05	23.39	20.16	22.45	21.82	23.95
S.D.	3.99	1.40	2.95	2.96	2.35	1.26	2.69	1.11	3.12	2.85	1.58
WEIGHT (KG.)	-	13.5	9.0	-	4.4	-	3.0	-	5.0	10.0	1.5

TABLE 6. THE NUMBER, LENGTH FREQUENCY, AND TOTAL WEIGHT OF DOGFISH PER SET.

LENGTH / SET	5			6			7			8			9		
(CM) /	M	F	T *	M	F	T	M	F	T	M	F	T	M	F	T
							FREQUENCY								
35-39	1		1							1	1	2	1		1
40-44	5		5	1	1	2				2		2			
45-49	2	3	5	1	1	2	1		1	6	8	14			
50-54	1	3	4	1	4	5	1		1	3	4	7	1	1	2
55-59	1	1	2	1		1		1	1	9	10	19	3	1	4
60-64	1	1	2		1	1	1		1	2	2	4			
65-69	1		1		1	1				4	3	7			
70-74	1		1				1		1					1	1
75-79	1		1										2		2
80-84	1		1												
NUMBER/SET	15	8	23	5	7	12	4	1	5	27	28	55	7	3	10
MEAN LENGTH	54	52	53	53	51	52	58	57	58	54	54	54	59	60	59
S.D.	14.2	4.3	11.8	8.6	5.6	7.1	9.6	-	8.6	8.1	7.1	7.3	13.0	8.5	11.9
WEIGHT (KG.)			24.5			12.0			7.0			58.0			15.0

* M = MALE, F = FEMALE, T = MALE AND FEMALE

TABLE 6 (CONTINUED).

LENGTH / (CM) / SET	10			17			19			28			32		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
	FREQUENCY														
35-39															
40-44										1		1			
45-49				1	1	2	1		1						
50-54	1		1		1	1		1	1				1	2	3
55-59		1	1		1	1	1	2	3		1	1			
60-64	1		1	1	2	3		1	1						
65-69											1	1			
70-74				1		1	1		1	1		1	1		1
75-79				2		2				1		1	2		2
80-84	1		1							1		1			
NUMBER/SET	3	1	4	5	5	10	3	4	7	4	2	6	4	2	6
MEAN LENGTH	65	57	63	67	56	61	59	57	55	68	59	66	69	52	64
S.D.	13.8	-	11.4	11.4	5.8	10.6	10.3	3.5	4.7	15.6	7.5	13.6	10.3	-	11.8
WEIGHT (KG.)			6.5			15.0			10.0			11.5			12.0

TABLE 7. THE NUMBER PER SET, AND LENGTHS, OF HERRING, DOGFISH, AND ROCKFISH WHEN THE NUMBER CAUGHT IN A SET WAS THREE OR LESS.

	HERRING		DOGFISH		ROCKFISH	
SET /	NUMBER	LENGTHS (CM)	NUMBER	LENGTHS (CM)	NUMBER	LENGTHS (CM)
1	3	6.5, 26.5, 28.5				
2	2	18.5, 19.5				
5	1	29.0				
7					1	41.0
13					2	43.0, 46.5
16			2	51.0 F, 80.0 M *		
18			1	78.0 M		
19	2	24.0, 25.0	1	70.0 M		
20					1	49.0
22	2	23.0, 26.0	2	62.0 F, 84.0 M		
33					1	38.0
					3	39.0, 41.0, 44.0

* M = MALE, F = FEMALE

TABLE 8. VERTICAL TEMPERATURE PROFILES AT SOME SET LOCATIONS AS READ FROM EXPENDABLE BATHYTHERMOGRAPH CHARTS.

SET /	DEPTH IN METERS 0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190
	CENTIGRADE DEGREES																			
CRUISE 1, JULY 3-7, 1987.																				
2	14.0	10.4	9.8	9.0	9.0	8.6	8.0	7.8	7.6	7.3	7.1	7.0								
4	14.2	12.2	10.7	10.2	9.9	9.6	8.3	8.0	7.6	7.5	7.2	7.2	7.0	6.8	6.7	6.7	6.6			
6	14.2	10.3	10.4	10.0	9.4	9.0	8.4	8.0	7.6	7.4	7.3									
8	14.2	14.1	11.5	10.6	10.0	9.3	8.7	8.4	7.7	7.5	7.2	7.0	6.8	6.7	6.5	6.4	6.4			
10	14.0	12.8	11.2	10.5	9.7	9.3	9.0	8.5	7.8	7.3	7.2	7.2								
11	14.0	12.8	11.5	10.7	10.0	9.7	9.3	8.0	8.0	8.0										
12	14.0	13.0	11.0	10.5	9.5	9.2	8.6	7.8	8.0	8.0										
14	11.5	11.0	10.5	9.7	9.1	8.7	8.5	8.0	8.0	7.7	7.2	7.0	6.7	6.7						
16	12.0	11.2	10.7	10.0	9.7	9.2	8.9	8.6	8.3	8.2	7.9	7.6	7.3	7.0	6.6	6.6	6.6			
18	12.0	9.4	9.2	10.0	9.8	9.2	9.1	8.7	8.4	8.0	7.2	7.2	6.6	6.5	6.5	6.3	6.3			
20	13.0	10.7	10.0	9.6	9.9	9.2	9.2	8.7	8.2	7.5	7.2	7.0	6.5	6.2	6.0	6.0				
22	11.0	9.5	9.5	9.3	9.0	8.7	8.5	8.3	8.2	8.1	7.9	7.5	7.0	6.7	6.2	6.1	6.0			
CRUISE 2, AUGUST 13-14, 1987.																				
30	12.0	11.7	11.5	10.0	9.8	9.5	9.0	8.9	8.5	8.0	7.5	7.5	7.4	7.2	7.2					
CRUISE 3, AUGUST 19-20, 1987.																				
46	13.5	12.2	11.0	9.5	9.0	8.4	8.0	7.8	7.4	7.0	6.4	6.3	6.2	6.2						
48	13.5	13.5	12.2	12.0	10.7	8.7	8.2	7.8	7.5	7.3	7.1	7.1								
50	13.0	13.7	12.3	10.5	9.3	9.0	8.2	8.1	7.7	7.7										
52	14.0	11.2	10.7	9.7	8.5	8.3	7.7	7.4	7.2	6.9	6.5	6.3	6.0	5.7	5.6	5.5	5.4	5.3	5.2	5.2

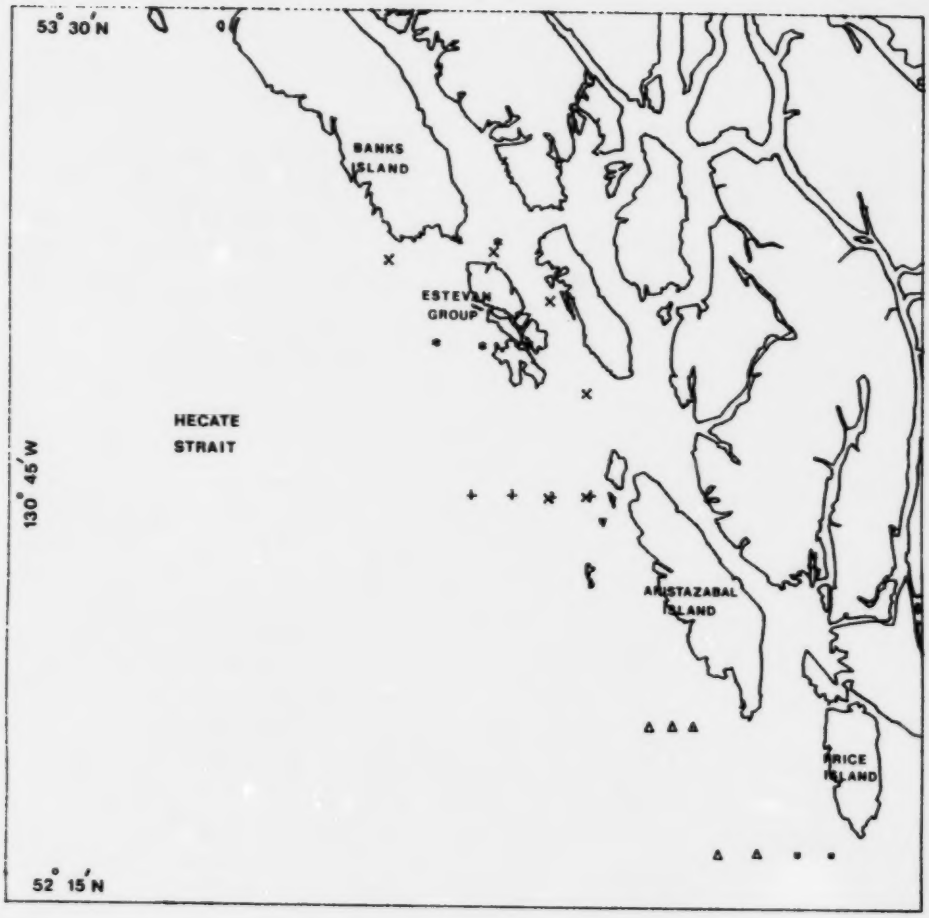

Fig. 1. Seine set locations on the July 3-7, 1987 cruise.

Key: ■ July 3
▲ July 4
\+ July 5
* July 6
x July 7

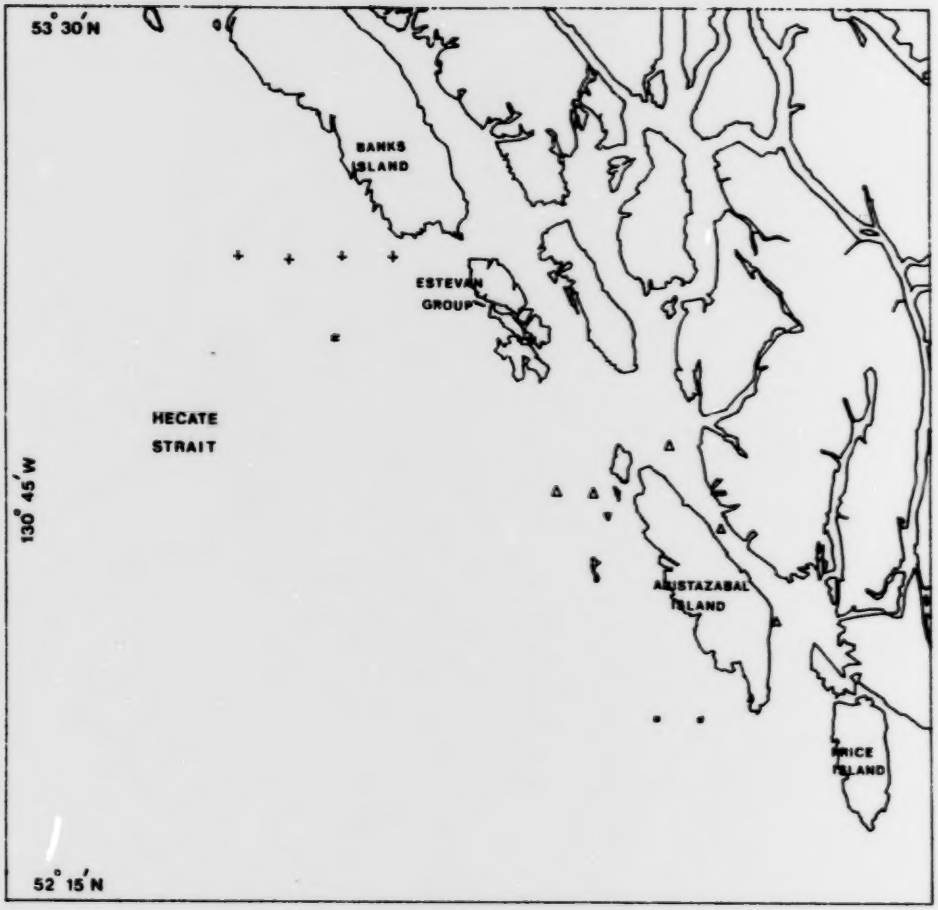

Fig. 2. Seine set locations on the August 13-14 and August 19-20, 1987 cruises.

Key:
- ■ August 13
- ▲ August 14
- \+ August 19
- * August 20